DOCUMENT RESUME

ED 091 572 CE 001 344

TITLE	Managing Highway Maintenance: Budget Preparation, Unit 9, Level 3.
INSTITUTION	Federal Highway Administration (DOT), Washington, D.C. Offices of Research and Development.
PUB DATE	Jan 73
NOTE	51p.; For related documents, see CE 001 339-343, 345, and 346
EDRS PRICE	MF-$0.75 HC-$3.15 PLUS POSTAGE
DESCRIPTORS	Autoinstructional Aids; *Budgets; Civil Engineering; *Maintenance; *Management Development; Manuals; Programed Instruction; Programed Units; *Road Construction; *Supervisory Training
IDENTIFIERS	*Highway Maintenance

ABSTRACT

Part of the series "Managing Highway Maintenance," the unit describes the essential steps in developing a maintenance budget, or performance budget, based on the work to be done. It is designed for field engineers and supervisors who assist department officials in preparing work programs and budgets. The format is a programed self-instructional approach in which information is presented in progressive segments or frames. (EA)

ED 091572

MANAGING HIGHWAY MAINTENANCE

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BUDGET PREPARATION

Management by Objectives Series

UNIT 9

LEVEL 3

FEDERAL HIGHWAY ADMINISTRATION
Offices of Research and Development
January 1973

This book is part of the series "Managing Highway Maintenance," prepared for the Implementation Division, Office of Development, Federal Highway Administration, under contract FH-11-7600. The series as a whole is described in the *Training Guide and Catalog* volume.

The contents of this book reflect the views of the contractor, Roy Jorgensen Associates, Inc. The contents do not necessarily reflect the official views or policy of the Department of Transportation.

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Implementation Division
Offices of Research and
Development

Washington, D.C.
January 1973

INTRODUCTION

This is "Budget Preparation." It describes the essential steps in developing a maintenance budget based on the work to be done -- a "performance budget." The training is designed specifically for field engineers and supervisors who are expected to assist Department officials in preparing work programs and budgets.

TRAINING TECHNIQUE

The information in this unit is presented in small segments -- called frames. Most frames require you to answer a question about the information in the frame. The answer you pick will instruct you to go to a different part of the unit. To complete the training:

+ CAREFULLY READ EACH FRAME.
+ FOLLOW THE DIRECTIONS AT THE END OF EACH FRAME.

Turn the page and read Frame 1.

Section One

MAINTENANCE BUDGETS

A budget is an estimate of the amount of money required to operate an organization for a definite period of time, usually one year.

1 (continued)

What is a maintenance budget?

A. The amount of money allocated to the Department for the year's work to be performed. Go to Frame 2.

B. An estimate of the amount of money required to perform the maintenance activities of the coming year. Go to Frame 3.

C. Both of the above answers are correct. Go to Frame 4.

2

That question was a bit unfair because all the answers are correct. This answer is right because, at the beginning of the fiscal year, a certain amount of money is allocated to maintenance activities. It's not an approximate amount -- it's precise. It is the amount of money the Department can spend. The Department can't spend more without receiving an extra grant.

The second answer is right also because, when the request is made for next year's required money, the request documents an estimate of the amount of money needed for maintenance.

The word "budget" applies to both the estimate of the required money and the actual amount which is eventually granted. This training treats the preparation of the budget -- the calculation of the estimated amount of money needed -- so we will use this meaning of "budget."

Go to Frame 5.

3

Right. Frame 1 defined a budget as an estimate of the amount of money required for next year's maintenance activities. In this training we will concentrate on the preparation of a budget; that is, calculating the probable expenses of the coming year.

However, the word "budget" can have another meaning. After a definite amount of money has been allocated to maintenance activities, this definite amount is called a budget. When we talk about staying within the budget, we are referring to this definite amount of money.

The budget can be either the estimate of needed money or the actual amount that finally comes through. Since this training deals with the preparation of estimates, we will use "budget" to mean an estimate of next year's expenses.

Go to Frame 5.

4

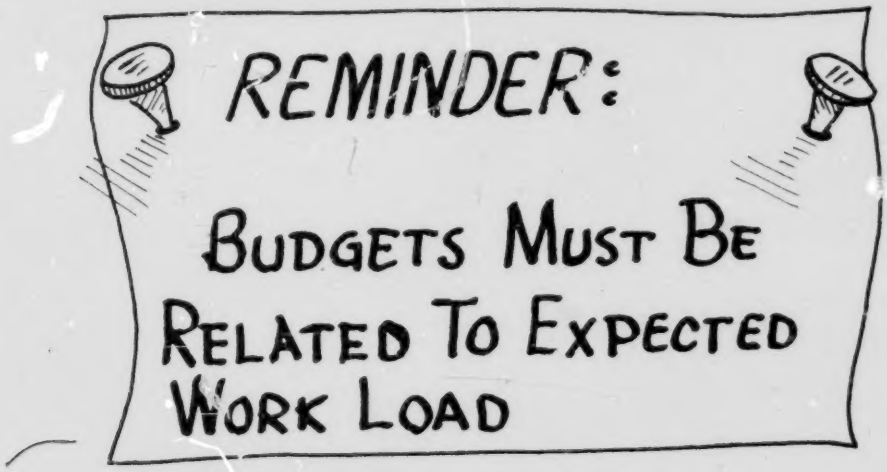
Right. Both answers are right because both definitions of "budget" are common.

On one hand, the budget is an estimate of the amount of money needed to do next year's maintenance activities. On the other hand, a budget is a definite amount of money given to the Department for maintenance. In this training, we'll use the first meaning -- an estimate of next year's expenses.

Go to Frame 5.

METHODS OF CALCULATING A BUDGET

There are several ways of estimating the cost of maintaining the highway system. All are ultimately related to how much work is expected to be done.



Which of the following methods of calculating the cost of maintenance is most related to the work to be done?

A. Use the amount of money granted in the last year's budget. Add about 10 percent for inflation and "increased and improved services." — Go to Frame 6.

B. Multiply the number of road miles maintained by $1,400 and the result is an estimate of the maintenance cost. — Go to Frame 7.

C. Multiply the number of employees by 10,500 and that's the estimate of maintenance costs. — Go to Frame 8.

D. Calculate the cost of everything to be done in the coming year and add all the costs together for the total estimate. — Go to Frame 9.

6.

No. However, this method is not without merit. It may weli be that the amount of work to be done next year is only about 6 percent more than this year's and the inflation rate is about 4 percent. The result will be about 10 percent more than this year's budget.

Go back to Frame 5 and make another choice.

7.

No, although this method certainly is based on a logical assumption: the more miles of road to be maintained, the higher the cost of maintaining the roads.

But there's a better method, one more directly involved with the actual work to be done -- in Frame 5. Go there and find it.

8

No, although there is some reason behind such a formula. The manpower in some way reflects the amount of work to be done, so multiplying the manpower level by some number could be a good estimate of the maintenance costs during the coming year.

Go to Frame 5 and find a better answer.

9

Right. This is the method most directly related to the work to be done. The other methods mentioned also have merit, but their connection to the work to be done is more remote.

Let's look at the first method: the last budget amount plus 10 percent. Maybe each year's budget does average about 10 percent over the previous year's, so this method isn't unfounded. However, it doesn't take specific activities into account.

There is one big disadvantage to this method -- a disadvantage which discourages administrations from using this simple method. What is it?

A. The political body which must approve the budget doesn't want to finance a program whose activities are not well documented. Go to Frame 10.

B. The amount of the last maintenance budget is very difficult to determine, so this year's budget becomes merely a guess. Go to Frame 11.

C. The big disadvantage is that people never add just 10 percent to last year's budget. They add more, which increases the chances of the budget not being approved. Go to Frame 12.

10

Right. If a program isn't prepared for using the funds, the funds won't be granted -- at least until a lot of questions are answered.

Another method mentioned was to estimate the cost of a year of maintenance by multiplying the number of miles of road maintained by $1,400. This method is very similar to the previous method. It's based on averages and not specifically on what should be done. But accountants, bookkeepers and statisticians like to express any budget, once calculated, in terms of dollars per mile. It gives them an approximation of the maintenance costs and useful data for statistical analysis.

This method can be improved by using other considerations besides just road mileage. For example, the class of the road can be considered. The cost per mile may then be:

Interstate	$1,800/mile
A	1,200/mile
B	900/mile
C	700/mile

10 (continued)

And if we add other factors such as annual average daily traffic volume (AADT), right-of-way width and age of the roadway, the following results might be:

Cost of Maintaining One Mile

Class	Basic Rate	AADT	ROW Width	Roadway Age
Interstate	$1,500	$5/thousand vehicles	$3/foot	$100/year
A	1,000	$5/thousand vehicles	4/foot	120/year
B	800	$10/thousand vehicles	4/foot	100/year
C	500	$20/thousand vehicles	5/foot	25/year

Thus, one mile of a 2-year old, 80,000-vehicles-per-day, Interstate highway, costs:

$$\$1,500 + (\$5 \times 80) + (\$3 \times 170) + (\$100 \times 2) = \$2,610$$

With each detail added to the consideration, the estimate becomes more convincing. But one difficulty remains in these "cost per mile" methods. What is it?

A. They are too simple to use. Go to Frame 13.

B. They are based more on past performance than on what should be done during the budget period. Go to Frame 14.

C. The number of details to be considered keeps increasing until the calculations become unwieldly. Go to Frame 15.

D. The calculations are too dependent on opinion; if two men do the calculating, two different costs per mile are found. Go to Frame 16.

11

No. The last amount approved for a maintenance budget is a matter of record. It should be very easy to find.

Go to Frame 9 and make another choice.

12

This answer is not really true. If calculating the budget were so simple, the formula would have to be followed -- too many people would notice if it weren't.

As far as the approval is concerned, the chances of approval probably aren't affected. If the political body would approve an amount equal to the last budget plus 10 percent, why wouldn't it approve the last budget plus 15 percent? Because the amount is too high? Well, maybe 10 percent is too h[illegible] also. The point is this: the people who allocate funds consider not only the amount, but also the reason for the amount. No real reason is given for the 15 percent -- and no reason is given for 10 percent either.

With all this in mind, go back to Frame 9 and try again.

13

No. Simplicity is seldom a problem. Some of the best techniques are simple. The technique of estimating the cost of a year of maintenance based on cost per mile has a difficulty -- and it's not simplicity.

Go to Frame 10 and find it.

Right. All these methods use cost-per-mile values which are arrived at from studying only past performance. No consideration is given to what maintenance activities should be performed during the coming budget period. This is true also of the method of calculating a budget based only on manpower level. There is nothing wrong with analysis of past expenses, but some study should also be made of what is to be done during the budget period.

Budgets which are based primarily on the cost of work to be done are called performance budgets. Usually the cost estimates in a performance budget are broken down by object of expenditure and activity. (Objects of expenditure usually are labor, equipment, material and contractual services.) The cost of labor is the salaries paid. The equipment cost is the amount needed to rent or buy, maintain and use the equipment. The cost of all the material to be used is the material cost. And when the Department lets a contract on some maintenance work, the amount of the contract is the cost of contractual services.

Thus, a specific activity on a performance budget may be:

	Labor	Equipment	Material	Contracts
Machine Mowing	$51,700	$35,000	—	$5,000

14 (continued)

And a performance budget can be translated into labor, pieces of equipment, kinds of material, and contracts. For example:

3 c.y. dump truck No. 0378	$1,704.00
3 c.y. dump truck No. 0379	1,704.00
Foreman No. 132-6891	8,500.00
Foreman No. 116-9172	8,470.00
Pit-run gravel	10,000.00
Asphalt sealant	4,000.00

A performance budget is an estimate of the cost of all the maintenance work or all work done by maintenance personnel during the coming year.

Which of the following best describes the information needed to prepare a performance budget?

A. What should be done next year. Go to Frame 17.

B. What should be done next year and how many resources are needed to do it. Go to Frame 18.

C. What should be done next year, how many resources are needed to do it, and how much each item costs. Go to Frame 19.

D. What should be done next year, how many resources are needed to do it, how much each item costs, and when it should be used. Go to Frame 20.

15

This could be true of the methods with many factors considered, but it certainly is not true for the simple case of cost per mile.

What we are saying is that all methods of preparing a budget on a cost-per-mile basis involve a logical difficulty. Find it in Frame 10.

16

No. There's nothing subjective about this method. If two men do the calculating, they both use the same data and they both end up with the same result.

Go to Frame 10 and try again.

17

Yes, but more information is needed. It's not enough to know merely what should be done next year. Remember, we're trying to estimate the cost of maintaining the roads next year.

Go to Frame 14 and answer the question again.

18

Not quite. Remember, the idea of a budget is to estimate the cost of next year's work to maintain the road system.

Try again in Frame 14.

19

Correct. In order to prepare a performance budget, the Department must know approximately how much of each activity should be done, how many men, machines and materials are required, how much time the work will take, and how much it will cost. The Department also has to have a way of keeping track of expenditures and their connection to specific maintenance activities.

Go to Frame 21.

20

Right, except that the budget can be made without knowing when each resource should be used.

Go to Frame 14 and make the choice again.

THE PROCESS OF CALCULATING A PERFORMANCE BUDGET

The process of developing a good performance budget begins with standards.

All major activities should have quality standards. Quality standards describe how deteriorated a roadway element should be before a particular activity should be performed. For example, the quality standard for joint and crack filling suggests that no crack less than $\frac{1}{4}$ inch wide should be filled. The quality standard for emptying litter barrels might be that litter barrels should be emptied when half of them are half full. Quality standards thus indicate the level of maintenance performed on roadway features.

Do quality standards suggest criteria for high quality workmanship in the particular activity?

A. Not usually. Go to Frame 22.

B. Probably so. Go to Frame 23.

22

Right. They describe how bad things are allowed to get before something should be done. If a very high level of maintenance is performed, things aren't permitted to get very bad before being repaired. If a low level of maintenance is offered, conditions can become very bad before any repairs are scheduled.

Quantity standards specify how much work probably has to be done -- on an average unit of roadway feature in one year -- in order to satisfy the quality standard. For example, in order to satisfy the quality standard for joint and crack filling, an average of two gallons of sealant must be poured on each lane mile of road. This is the quantity standard. For servicing litter barrels, maybe an average of once a week is sufficient to satisfy the quality standard. This is the same as 52 barrels serviced for every barrel found on the roadway feature inventory, or 52 barrels serviced per barrel. So the quantity standard is 52 barrel-servicings per barrel.

Do quantity standards state the amount of work anticipated for a particular activity?

A. No. Go to Frame 24.

B. Yes. Go to Frame 25.

23

This is the wrong answer. Quality standards help to determine whether or not work should be done. They usually do not offer any suggestions as to how best to do the job.

Take a look at Frame 22.

Right. They state the average amount of work to be done on one unit of the feature being repaired. For example, 52 barrel-servicings per barrel tells the approximate amount of work (52 servicings) done on one barrel -- not on all the barrels.

When the inventory is considered with the quantity standards, a work program can be developed. If there are 6,000 litter barrels, and each one is serviced 52 times a year, the amount of litter barrel servicings for the year comes to 312,000 -- and this is an item on a work program. A segment of a work program might look like this:

Joint and Crack Filling	20,000 gallons of sealant
Premix Patching	3,000 tons of premix
Cleaning Drainage Structures	8,000 structure cleanings

What information does a work program provide?

A. It indicates the activities which are planned for the coming year. — Go to Frame 26.

B. It shows the amount of work planned for the coming year. — Go to Frame 27.

C. It shows the kinds and amounts of work planned for the coming year. — Go to Frame 28.

25

This is not the correct answer. Quantity standards give the average amount of this work needed on one item of the inventory. In joint and crack filling, two gallons of sealant aren't the year's quota for this operation; two gallons are the amount of crack filling performed on one lane mile.

Go to Frame 22 and answer the question again.

26

No. It does more than indicate just the kinds of activities planned for the coming year. If a work program gave information only about activities, a segment might look like this:

Joint and Crack Filling
Premix Patching
Mowing

Go to Frame 24 and try again.

27

No. It has to show more than just the amount of work. Otherwise, a work program would be just a simple statement: Next year approximately 800,000 man-hours of work are planned.

Go to Frame 24 and try again.

28

Right. A work program indicates the kinds and amounts of work planned for the coming year.

When a price tag is put on the resources required to accomplish the work program, the budget is developed. The standards show how many men, machines and materials are needed for each activiiy, and the cost of all these resources -- for all the activities -- is the Department's maintenance budget.

There are always some activities which have no standards, are difficult to price, or whose resource requirements vary; and in these cases, the cost can often be little more than a best guess. But that's all right. If guessing is the last resort, the "best guess" is an approved method.

Let's go into detail with some cases -- in Frame 29.

29

Suppose the work program shows 3,000 tons of premix as the amount of Premix Patching to be done in the coming year.

The maintenance standard includes the following information:

CREW SIZE:	2
DAILY PRODUCTION:	3 tons
MATERIAL:	premix
EQUIPMENT:	1 dump truck rakes, shovels, brooms and buckets

29 (continued)

From this information, the following data can be calculated:

Crew Days:	3,000 tons ÷ 3 tons/day	=	1,000 crew days
Daily Labor:	2 men X 8 hours	=	16 man-hours
Yearly Labor:	16 man-hours/crew day X 1,000 crew days	=	16,000 man-hours
Equipment:	1 truck X 8 hours X 1,000 crew days	=	8,000 truck-hours

If the costs of labor, equipment and material are known, a Premix Patching budget can be developed. Suppose the following prices apply:

Labor:	$3.20/man-hour
Dump truck:	0.60/truck-hour
Small tools:	0.50/crew day
Premix:	9.00/ton

The costs are therefore:

Labor:	$3.20/man-hour X 16,000 man-hours	=	$51,200
Equipment:	$0.60/truck-hour X 8,000 truck hours	=	4,800
Small tools:	$0.50/day X 1,000 days	=	500

What would be the cost of the material in this case?

A.	$27,000.	Go to Frame 30.
B.	$9,000.	Go to Frame 31.
C.	$3,000.	Go to Frame 32.
D.	Can't say; the amount of material is not given.	Go to Frame 33.

30

Right. The work program says that 3,000 tons of Premix Patching are planned for next year. At $9.00 a ton, that makes $27,000 worth of materials.

The total amount of money needed to do the expected amount of Premix Patching is the sum of the costs of labor, equipment, materials and contractual services.

Labor	$51,200
Equipment	5,300
Materials	27,000
Contractual Services	-
Total	$83,500

If this sort of analysis is done for each activity on the work program, the total amount will be the Department's maintenance budget.

Let's try one more example.

Suppose the work program provided for 1,400 cubic yards of Spot Patching Shoulders. Here are the useful data:

CREW SIZE:	2	($3.20/man-hour)
DAILY PRODUCTION:	3.5 cubic yards	
MATERIAL:	Pit-run gravel	($4.60/cubic yard)
EQUIPMENT:	1 dump truck	($0.75/truck-hour)
	1 loader	($1.25/loader-hour)
	Shovels, rakes, brooms, etc.	($0.75/day)

30 (continued)

In the space below, calculate the amount of money needed for each resource -- labor, equipment and materials.

The total -- by object of expenditure -- should be:

	Labor	Equipment and Tools	Materials	
A.	$20,480	$ 6,700	$ 6,440	Go to Frame 34.
B.	71,680	23,450	22,540	Go to Frame 35.
C.	8,960	23,450	22,540	Go to Frame 36.
D.	35,840	11,725	11,270	Go to Frame 37.
E.	I don't know.			Go to Frame 38.

31

No. The cost could be found by multiplying the price of one ton ($9.00) by the number of tons to be used during the year. The result is not $9,000.

Go to Frame 29 and try again.

32

No. Multiply the price of one ton ($9.00) by the number of tons to be used during the year. The answer is not $3,000.

Go to Frame 29 and choose again.

33

This is not true. The amount of material to be used during the year is given in the work unit for Premix Patching. Answer the question, "How much Premix Patching is planned for next year?" and your problem is solved.

Go back to Frame 29.

34

Right.

Do you want an explanation?

A. Yes. Go to Frame 38.

B. No. Go to Frame 39.

35

No. You either made a wild guess or thought that the work program provided 1,400 crew days of Spot Patching Shoulders.

If you're still game, go back to Frame 30 and try again. Otherwise, go to Frame 38.

36

No. You either made a wild guess or you thought that 2 men times 1,400 cubic yards resulted in 2,800 man-hours for labor (not so) and calculated the equipment and material costs based on the wrong assumption that the work program provided 1,400 crew days of this activity.

Want to try again?

A.	Yes.	Go to Frame 30.
B.	No.	Go to Frame 38.

37

No. You thought that the work program showed the equivalent of 700 crew days of this activity. This is not so.

Go to Frame 30 and guess again.

Here's an explanation of how to figure the cost of this operation:

The daily production is 3.5 cubic yards and the work program quantity is 1,400 cubic yards. So:

1,400 ÷ 3.5 cubic yards/day = 400 days

There are 400 crew days planned. Since there are 2-man crews and 8-hour days, each crew day is 16 man-hours. And since each man-hour costs an average of $3.20, we have:

400 crew days X 16 man-hours/crew day X $3.20/man-hour = $20,480 (labor)

The equipment costs are:

$0.75/hour for 1 dump truck
1.25/hour for 1 loader
or $2.00/hour for both,

and

400 crew days X 8 hours/day X $2.00/hour = $ 6,400 (equipment)

The costs for small tools are:

400 crew days X $0.75/day = $ 300 (small tools)

The 1,400 cubic yards of gravel, at $4.60/cubic yard, cost = $ 6,440 (materials)

That's all there is to this type of calculation. Find out how many crew days are provided on the work program by dividing the year's work quantity by the daily production. Then the rest is easy:

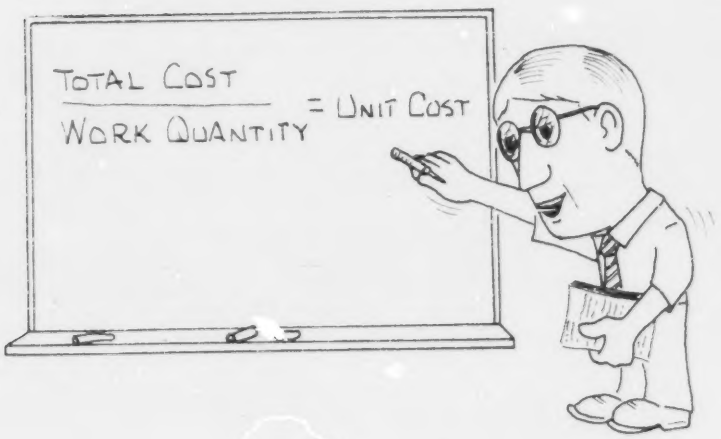
Labor Cost = Crew size X 8 hours/day X crew days X average hourly wage.
Equipment Cost = Total hourly or daily equipment charge X crew days.
Materials Cost = Amount of material anticipated X cost for one unit.

Go to Frame 39.

39

Notice that the idea of a "unit cost" can be developed. In the Premix Patching example, 3,000 tons of premix were provided and the cost of this work was estimated at $83,500. The unit cost would be the price of one ton of Premix Patching, including labor and equipment. In this case it would be:

$83,500 ÷ 3,000 tons = $27.83 per ton.



The unit cost for each activity is a very useful bit of information. It can be used to do budget calculations more easily next time. It is also useful for adjustments to the work program and the budget during the year.

"The year is over and we needed all but 500 tons of the Premix Patching provided on the work program. How much money have we saved?"

A. $500. Go to Frame 40.

B. $13,915. Go to Frame 41.

C. $5,000. Go to Frame 42.

40

No. They saved 500 tons of material on an activity in which one ton costs $27.83.

Try again at Frame 39.

41

Right. At $27.83 a ton, 500 tons cost $13,915. This amount of money can then be applied to some other activity which has overshot its budget.

Another way of calculating the budget involves calculating all the resources needed for the work program and putting a value on each resource. It doesn't sound any different from the first method, does it? Here's the difference: the first method evaluated all the resources for one activity at a time; the second method identifies the resources needed for each activity, and then gathers them all together and calculates the cost. The two methods should yield identical results, but each method has its interesting sideline. The first method allows us to calculate a unit cost; the second does not. The second allows us to calculate the manpower and equipment levels to be maintained; the first does not. We will explain this last point.

PARTS OF BUDGET CALCULATION

FIRST METHOD

Activity	Costs			
	Labor	Equipment	Materials	Total
Premix Patching	$51,200	$ 5,300	$27,000	$83.500
Spot Patching Shoulders	20,480	6,700	6,440	33,620
⋮	⋮	⋮	⋮	⋮

SECOND METHOD

	Quantities
Regular Labor	800,000 man-hours
Summer Labor	600 man-hours
3-yd. Dump Truck	14,000 equipment-days
5-yd. Dump Truck	2,000 equipment-days
½-yd. Loader	1,500 equipment-days
⋮	⋮

41 (continued)

The second method involves calculating the total man-hours, equipment days for each type of equipment, and quantities of each type of material. Notice that to keep things simple, we are using equipment days instead of hours. Since there are about 2,000 hours of work per year for each man, and about 240 days per year for a piece of equipment, the manpower and equipment levels can be calculated as follows:

Number of Employees Needed = Total number of man-hours ÷ 2,000

Number of Pieces of Equipment Needed = Total number of equipment days ÷ 240

For example, suppose the total number of man-hours required by the program were 800,000. The manpower level would be:

800,000 ÷ 2,000 = 400 men

If 3-yd. dump trucks are needed for 14,000 equipment days, the Department should have:

14,000 ÷ 240 = 59 3-yd. dump trucks.

If 2,000 equipment days of work are provided for 5-yd. dump trucks, how many such trucks does the Department need?

A.	80.	Go to Frame 43.
B.	8.	Go to Frame 44.
C.	40.	Go to Frame 45.

42

No. If a 500-ton savings amounted to $5,000, then each ton in place would cost only $10. That would be great news for the Department, especially when the premix itself costs $9.00 a ton.

Make another choice in Frame 39.

43

No. If the work program provides for 2,000 days of work for a 5-yd. dump truck, and there are only 240 work days in a year for a truck, then the number of trucks required is:

$$2{,}000 \div 240.$$

Go to Frame 41 and answer the question again.

44.

Right. There may still be one problem: how to find the total man-hours and equipment days required by the work program. The process is basically the same as that used in the first method. (Glance back at the first three paragraphs of Frame 29, if you've forgotten.) The big difference is that costs aren't calculated for one activity.

By using maintenance standards with the work program, the table shown on the next page can be drawn up.

44 (continued)

Activity	Total Manpower (man-hours)	3-yd. Dump (days)	5-yd. Dump (days)	Tractor (days)	¼-yd. Loader (days)
Premix Patching	16,000	1,000	-	-	-
Spot Patching Shoulders	6,400	400	-	-	400
Mowing	30,000	-	-	3,750	-
Annual Leave	32,000	-	-	-	-
Total Resources	800,000	14,000	2,000	4,500	1,500
Cost	$2,560,000	$99,400	$16,000	$22,500	$15,000
	Labor	Equipment			

If the resource requirements calculated in this way don't correspond with the actual levels in the Department, something has to change. If the work program requires 400 men and the Department has 320 employees in the field, the work program is too much for them. Either more people must be hired or the work program must be trimmed.

This second method of calculating the budget provides what benefit?

A. It enables the Department to calculate the cost of the work program. Go to Frame 46.

B. It provides a "unit cost" for each activity which facilitates planning during the year and next time the budget comes up again. Go to Frame 47.

C. It provides an easy way of checking whether the staffing and the equipment inventory are adequate for the work program. Go to Frame 48.

45

No. You guessed.

Go to Frame 41 and try again.

46

Any method does that. That's the purpose behind the budget. This is not the best answer available in Frame 44.

Go back. Frame 44.

47

No. This method does not provide a unit cost. The first method does.

Look back at Frame 39 if you can't remember. Then go to Frame 44 and try again.

48

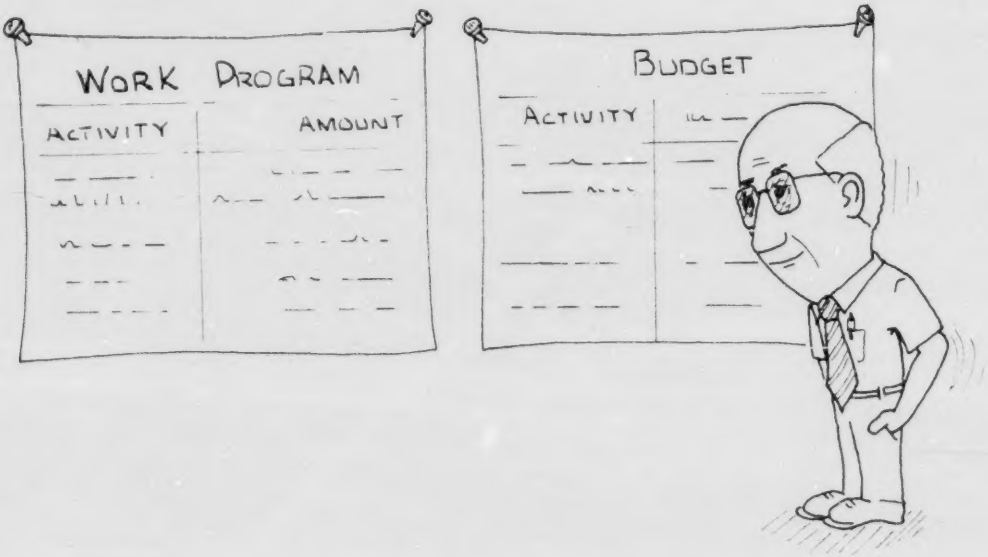
Right. The second method facilitates the calculation of total resource requirements.

Where do we get the cost estimates we've used? Usually the costs are a matter of record. The wages of the workers can easily be found. The equipment cost is the cost of renting or keeping up equipment, plus the cost of using it. The cost for materials also is easy to find. In all cases, the present costs or the predicted costs (whichever are higher) should be used. When contracts are let on maintenance work, the cost is part of the contract.

Up to this point, the preparation of a budget seems pretty easy. And, in theory, it is. The work program shows what has to be done. Standards indicate how it is to be done and what is needed to do it. And records show how much each item costs. The total cost of the whole work program is the maintenance budget.

After the budget is completed, and the Department is satisfied with the estimates, it is submitted to a political body for approval. Some departments have special ways of submitting the budget. But all departments are required to justify their estimates and requests. Sometimes a well documented budget is not approved, and sometimes an outlandish one is.

Go on to Frame 49.



Section Two

RELATIONSHIP BETWEEN WORK PROGRAMS AND BUDGETS

49

A budget is the estimated cost of the work program. If the work program is big, the budget will be big. And vice versa. So, if the budget is cut, the work program must be cut.

This is not unusual. The political body which votes on the maintenance budget has to try to please not only the people in maintenance, but also those in design, planning and construction -- and agencies such as police and fire departments, schools, and more. Not everyone receives what he thinks he needs. So when the maintenance budget gets the axe, the Department must know what to do.

49 (continued)

What must be done if the maintenance budget is reduced?

A.	Employees must be laid off.	Go to Frame 50.
B.	The Department will just have to continue according to its plans until the funds run out.	Go to Frame 51.
C.	The Department will have to change plans.	Go to Frame 52.

50

This is a rather extreme measure. It may be necessary, but it might be avoidable too. In any case, this course of action shouldn't be considered unless the situation is first analyzed.

Go to Frame 49 and try again.

51

No. If you were planning on a trip to Hawaii and suddenly the funds had to be used for some other purpose, would you still pack your bags and ask your neighbor to drop you off at the airport? No. When the funds go away, the plans have to change.

Make a better choice in Frame 49.

52

Right. When the funds are reduced, the plans have to change. Since a budget is the estimated cost of the work program, if the budget is reduced, the work program has to be reduced. And, more often than not, the budget is cut. Typical cuts might be from one to six percent.

How are work programs changed to fit a reduced budget? Basically by changing the quality standards. When the quality standard is lowered, the level of maintenance goes down, which lowers the quantity standard -- the average amount of maintenance needed to satisfy the quality standard. When the quantity standard goes down, the amount of work on the work program is reduced. The difficulty of this readjustment is in choosing which activities to reduce and how much to reduce them in order to fit the budget.

Will a reduced work program require that the labor force be reduced by layoffs?

A.	Yes.	Go to Frame 53.
B.	Maybe.	Go to Frame 54.
C.	No.	Go to Frame 55.

53

Not necessarily. It may seem impossible not to reduce the number of employees, especially in light of our discussion of resource requirements, but it is possible.

Go back to Frame 52 and try again.

54

Correct. Sometimes the labor force has to be reduced. When this is necessary, the best way is through attrition. If no more hiring takes place, the manpower level will eventually reach the desired point.

Often, the labor force can stay at the same level even though the year's work plan is changed. This is done by reducing activities which use expensive material and adding work to marginal activities or to some special project which do not use material. In this way the manpower requirements stay the same, but the cost of materials goes down. Hopefully, the reduction in materials costs will balance the budget cut.

Can the amount of work be reduced and still require the same manpower?

A. Yes. Go to Frame 56.

B. Strictly speaking, no. Go to Frame 57.

55

Not always. Sometimes there is no other choice when budget cuts are sizable.

Make another choice in Frame 52.

56

This is not true. If the amount of work on the work program is only reduced, the manpower requirements are correspondingly reduced.

Think about it. Then go back to Frame 54.

57

Right. When the amount of work on the work program is reduced, then the manpower requirement is also reduced. But when some activities are cut and others are are expanded, it's possible for the manpower level to remain constant while the budget goes down.

Let's look at an example. Suppose part of the maintenance budget looks like this:

Mowing	30,000 acres	$ 123,000
Seal Coat	120 lane miles	54,000
Clean and Reshape Ditches	180 ditch miles	146,000
-		-
-		-
-		-
Total Budget		$2,420,000

If the Department's mowable acreage is to be mowed five times a year, how many acres does the Department have?

A. 3,000 acres. Go to Frame 58.

B. 5,000 acres. Go to Frame 59.

C. 6,000 acres. Go to Frame 60.

58

No. If each acre is mowed five times, the total number of acres mowed would be 30,000. How many acres are there?

Go back to Frame 57.

59

No. If there were 5,000 acres, and each one were mowed five times, then a total of 25,000 acres would be mowed. That isn't the case here.

Go to Frame 57 and try again.

60

Right. There are 6,000 acres, and each one is mowed five times. The total is 30,000 acres mowed.

Here are some pieces of information from the maintenance standards of the three activities:

	Mowing	Seal Coat	Clean & Reshape Ditches
CREW SIZE:	1	20	5
DAILY PRODUCTION:	8 acres	6 lane miles	$\frac{1}{4}$ ditch mile

Remembering that the work program shows 30,000 acres, 120 lane miles and 180 ditch miles for these activities, we can calculate the manpower needed.

60 (continued)

For Seal Coat, each crew day consists of 20 X 8 = 160 man-hours, and 6 lane miles of work are accomplished. Since 120 lane miles ÷ 6 lane miles/day = 20 days, the work program provides for 20 crew days of Seal Coat. At 160 man-hours per day, this amounts to 3,200 man-hours.

Do the same sort of calculation on the ditch work and mowing.

What are the manpower requirements in man-hours?

	Mowing	Seal Coat	Clean & Reshape Ditches	
A.	30,000	3,200	28,800	Go to Frame 61.
B.	240,000	3,200	36,000	Go to Frame 62.
C.	3,750	3,200	3,600	Go to Frame 63.

61

Right. In the case of Mowing, at 8 acres per day, how many days would be needed to mow 30,000 acres?

$$30{,}000 \div 8 = 3{,}750 \text{ crew days}$$

A one-man crew puts in 8 man-hours per day, so in 3750 crew days, there would be:

$$3{,}750 \times 8 = 30{,}000 \text{ man-hours}$$

In the case of Cleaning and Reshaping Ditches, how many crew days would be needed to work 180 ditch miles at a quarter mile per day?

$$180 \div \tfrac{1}{4} = 720 \text{ crew days}$$

Five men make one crew day equal to 40 man-hours. So 720 crew days would be:

$$720 \times 40 = 28{,}800 \text{ man-hours.}$$

Here's a summary of what we know about the situation so far:

Mowing*	30,000 acres	(30,000 man-hours)	$ 123,000
Seal Coat	120 lane miles	(3,200 man-hours)	54,000
Clean & Reshape Ditches	180 ditch miles	(28,800 man-hours)	146,000
=			=
=			=
=			=
Total Budget			$2,420,000

* 6,000 acres are mowed 5 times.

61 (continued)

Now suppose the Department's maintenance budget was cut by $24,000 -- a mere one percent. What can we do?

First, we could to what first comes to mind: reduce the mowing quality standard so that the frequency goes down from five to four times a year.

Would this change save the Department the $24,200?

A.	Yes.	Go to Frame 64.
B.	No.	Go to Frame 65.
C.	Only if the manpower level were reduced.	Go to Frame 66.

62

No. You must be guessing.

To find the number of crew days, divide the work program quantity by one day's quantity. Once you know how many days the crew will be working, it's pretty easy to find how many man-hours they'll put in.

Go back to Frame 60 and try again.

63

No. You have calculated the number of man-days instead of man-hours. Or you guessed.

Remember how this calculation was carried out back in Frame 29. We found the number of crew days by dividing the activity total of work by the amount of work done in one day. Knowing the crew size, and the number of hours in a work day, you can easily calculate man-hours for the total amount of work.

Try it in Frame 60.

64

This could be the right answer. But there's a better answer available.

Go to Frame 61 and find it.

65

This answer could be right -- depending on what you think is involved in reducing the work program.

But there's a better answer that does not depend on what you're thinking.

Go to Frame 61 and try again.

66

Right. By mowing only four times a year, we cut the mowing bill by a fifth.

$123,000 ÷ 5 = $24,600

Each of the five mowings would cost about $24,600. By mowing only four times, the Department saves $24,600 in mowing. However, a great portion of that money is the salary of the tractor-mower operators. So long as these operators are kept on the payroll, $24,600 won't be saved. More like $9,800 would be saved.

We need some cost information to make the right choice. Sometimes this type of information is found on maintenance standards.

UNIT COSTS

Activity	Labor	Equipment	Materials	Total
One Acre Mowed	$ 2.46	$ 1.64	$ -	$ 4.10
One Lane Mile Sealed	49.50	22.50	378.00	450.00
One Ditch Mile Reshaped	454.22	356.89	-	811.11

From this chart you can see that by not mowing those 6,000 acres the fifth time, $14,760 ($2.46 X 6,000) would be saved in labor, and $9,840 ($1.64 X 6,000) would be saved in equipment if employees were released. How many employees would have to be released?

A. Three — Go to Frame 67.

B. Nineteen. — Go to Frame 68.

C. Eleven. — Go to Frame 69.

Right. If 30,000 man-hours are needed to mow 30,000 acres, 6,000 man-hours are needed to mow 6,000 acres. There are about 2,000 hours in a work-year, so three men would work 6,000 man-hours in a year.

Three is a small number, so it's very probable that the manpower level could be reduced by three by attrition in a short time. But let's try to cut out $24,200 without losing any men. Let's not change Mowing.

Again, the information we have about the other activities is:

Activity	Work Program	Budget	Unit Costs			
			Labor	Equipment	Materials	Total
Seal Coat	120 lane miles (3,200 man-hours)	$ 54,000	$ 49.50	$ 22.50	$378.00	$450.00
Clean and Reshape Ditches	180 ditch miles (28,800 man-hours)	146,000	454.22	356.89	—	811.11
-		-				-
-		-				-
-		-				-
	TOTAL BUDGET	$2,420,000				

67 (continued)

Notice that the unit cost for Seal Coat is about 84 percent materials. Seal coating is an activity which is more preventive, than corrective, maintenance. Reducing the amount of sealing thus presents no great safety hazard. If we could reduce sealing to the extent necessary to save $24,200 in materials, the corresponding free manpower and equipment could be used to bolster an activity which needs them. Let's try it.

If one lane mile of sealing uses $378.00 in materials, how many lane miles will use materials worth $24,200?

24,200 ÷ 378 = 64 lane miles

If 64 lane miles of sealing were trimmed from the work program, how many man-hours would be freed?

A.	About 64.	Go to Frame 70.
B.	About 1,720.	Go to Frame 71.
C.	I don't know.	Go to Frame 72.

68

No. If 30,000 acres require 30,000 man-hours to be mowed, then 6,000 acres would need 6,000 man-hours. How many men would be needed to do 6,000 man-hours of work in one year? Not nineteen.

Try again in Frame 66.

69

No. If 30,000 man-hours are needed to mow 30,000 acres, then 6,000 man-hours are needed to mow 6,000 acres. Eleven men could put in 6,000 man-hours in less than 69 days.

Make another choice in Frame 66.

70

No. You're guessing.

Go to Frame 72 for an explanation.

71

Right. If 64 lane miles of sealing are removed from the program, about 1,720 man-hours are freed. These must be assigned to other useful work in order to really save the Department $24,200.

Do you want an explanation of how the man-hours were calculated?

A. Yes. Go to Frame 72.

B. No. Go to Frame 73.

72

Here's an explanation.

If 3,200 man-hours are required for 120 lane miles of sealing, then about 27 man-hours are needed for each lane mile. And about 1,728 (64 X 27) man-hours are required for 64 lane miles.

Go on to Frame 73.

73

We now have about 1,720 man-hours unassigned. They must be used to do some useful work. Let's see how they would affect the ditch reshaping activity.

At 160 man-hours per ditch mile (28,800 ÷ 180), the ditch reshaping activity could be increased by 10 or 11 miles to use the 1,720 man-hours (1,720 ÷ 160 = 10.7). Except for a slight difference in the equipment costs, the problem is solved.

In actual practice, a one percent budget cut is small. A five percent cut would mean more juggling of manpower, materials and equipment. But the theory would be the same as in the example we have just discussed.

When the budget is cut -- and when it is not desirable to reduce manpower levels -- then the following steps should be taken to adjust the work program:

+ Choose activities which can be scaled down without presenting a safety hazard, and whose cost is mainly material or equipment.

+ Choose other activities which could be increased without wasting money and effort, and whose cost is mostly manpower.

+ Reduce the first activities and increase the second ones so that the total budget is reduced by the desired amount and the manpower level is maintained.

Go to Frame 74.

Here is a summary of the main points in this unit:

+ A maintenance budget is an estimate of the cost of maintaining the roads for a year. There are many ways of estimating this cost, but the most reliable and believable way is by analyzing and applying known costs to the items on the work program. A budget which is directly based on the work program is a performance budget.

+ A performance budget is impossible to develop without a management system. The budget preparation begins with standards and the roadway inventory. From them comes the work program. When costs are applied to the work program, the result is the budget.

+ In the course of preparing a budget, resource requirements must be calculated. If the Department has too large or too small a staff, too little equipment or not enough material, this can be shown. And then, of course, something has to be done about it.

+ When the budget is cut, the work program must somehow be made less expensive. Usually the Department tries to keep the labor force constant, but reducing the material or equipment costs are good ways of reducing the budget.

+ Equipment or material costs can be reduced by adjusting some activities up and others down, cutting those activities which might have high materials or equipment costs and increasing those activities which are mainly labor.